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Abstract

The "Biological Agricultural Reactor Netherlands" -BARN-

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The "Biological Agricultural Reactor Netherlands" of the Institute for the Application of Atomic Science in Agriculture at Wageningen has been designed by Reactor Centrum Nederland and has been specially equipped for fundamental and applied research in the agricultural and biological field. The reactor, a modified swimming pool type with a power of 100 kW, is used as a source for thermal and fast neutrons to perform irradiations of both chronic and acute nature.

The reactor is equipped with the following irradiation facilities:

- 1) Climatological controlled irradiation room of 5 x 7 meters and 3 meters high for thermal and fast neutron irradiations.
- 2) Thermal column with a thermal neutron irradiation facility of 70 x 70 x 30 cm.
- 3) Two 150 mm diameter beamtubes.
- 4) Reflector positions in the lateral graphite reflector of the reactor core. Provisions have been made for future installation of max. 3 pneumatic rabbit systems with their irradiation stations in the lateral reflector of the reactor core.

The main special feature of this reactor is the neutron irradiation room situated directly below the reactor core. As this implied that the reactor fuel had to be as close to the pool bottom as practically possible, in order to reduce neutron losses in the pool water to a minimum, a very special core support system was designed. In this core support system there is no conventional grid plate, and the MTR type fuel elements are suspended in an egg crate type lattice.

The neutrons from the core streaming in downward direction, pass through a heavy water filled diffusor of special shape with overall dimensions of 120 cm length and 125 cm diameter, and through a system of gamma filters made

of pure bismuth with a total thickness of 17.5 cm. The neutrons entering the irradiation room have a low gamma contamination (about 10%) and a low fast flux contamination (cadmium ratio for gold >350). The irradiation field provided, is at least 2 m^2 in surface, with an average thermal neutron flux of 5.10^6 neutrons/sec.cm² when the reactor is operated at 100 kW. The maximum local variation in flux is $\pm 5\%$ relative to the average value.

Fast neutron irradiations can be performed either by transforming the thermal flux in fast flux by means of a fission plate or by reducing the heavy water layer between core and irradiation room and use of thermal and epithermal neutron filters.

The irradiation room itself can be completely controlled regarding temperature, humidity and light intensity. All free surfaces of the room are lined with special materials to limit radiation scattering, activation and production of capture gamma's.

To permit independent operation of the thermal column facility when the reactor is in operation, the shielding door of the thermal column has been so designed that experiments up to 70 x 70 x 30 cm in size can be transferred in and out the facility with the reactor operating at full power.

During the commissioning of the reactor and its facilities from April - September 1963, various experiments were carried out and extensive neutron flux and gamma flux measurements were performed. Especially the measurements in the irradiation room were difficult to perform. To obtain reliable gamma measurements, calibrated graphite-CO₂ filled ionisation chambers and Li⁶-Sn-Pb shielded GM-counters were used. Neutron flux measurements were performed using BF₃-counters and foil activation methods. It was experienced that the various techniques did not always give consistent results. Detailed results of these measurements and techniques used will be given in the paper.

